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Mr. Chairman, Members of the Subcommittee, I appreciate the opportunity to be here today in Minnesota to testify about the future of renewable energy in America's rural communities. I especially appreciate the opportunity to testify with Deputy Secretary of Agriculture Moseley. Our agencies have forged a close and extremely productive relationship in the past few years. I also want to commend the Chairman for his leadership in this area, both on this Committee and the Science Committee where we talked just a couple of weeks ago about the President's Hydrogen Fuel Initiative. I hope that the discussions and relationships established here today will help us continue to strengthen our cooperative efforts to promote renewable energy and economic growth in rural America.

This Administration's strong commitment to the development and deployment of renewable energy is without question. The Department of Energy (DOE) FY 2005 budget request for renewable technologies totals $374.8 million, a $17.3 million increase over the FY 2004 appropriation. We have requested increased funding in our programs for wind, hydropower, geothermal, hydrogen, and, when impact of Congressional earmarks is taken into account, solar and biomass as well. Over the past three years we have invested more than $984.7 million in research, development and deployment of renewable energy technologies.

And that investment is paying off. Technology has brought us great strides in improved performance and competitiveness of renewable technologies. And the benefits of renewable energy are as abundant as the resource itself – minimal environmental impact, economic growth, and enhanced energy security. My testimony today will focus on the programs in the DOE Office of Energy Efficiency and Renewable Energy to develop and deploy renewable energy technologies and the barriers we have identified to our success.

Biomass and Biorefinery Program

Biomass – agricultural crops, trees, wood wastes, plants, grasses, fibers, animal and other wastes – represents an abundant, domestic and renewable source of energy that has tremendous potential to increase domestic energy supplies. Many think of biomass mainly as a source for liquid fuel products such as ethanol and biodiesel. But biomass can also be converted to a multitude of products we use every day. In fact, there are very few products that are made today from a petroleum base, including paints, inks,

adhesives, plastics and other value-added products, that cannot be produced from biomass.

The Department estimates that the total available domestic biomass, beyond current uses for food, feed, and forest products, is between 500-600 million dry tons per year. Within the continental U.S., we can literally grow and put to use hundreds of millions of tons of additional plant matter per year on a sustainable basis. These biomass resources represent about 3-5 quadrillion Btus (quads) of delivered energy or as much as 5-6 percent of total U.S. energy consumption. In terms of fuels and power, that translates into 60 billion gallons of fuel ethanol or 160 gigawatts of electricity. This is enough energy to meet 30 percent of U.S. demand for gasoline or service 16 million households with power.

The goal of our Biomass program is an integrated approach to the simultaneous production of liquid fuels, power and products. While it is difficult to make fuels or products or power alone at a competitive cost, simultaneous production of products and electricity provides synergies that can lower production cost significantly. As we state in the Office of Energy Efficiency and Renewable Energy Strategic Plan, we are working toward the day when "rural America is revitalized through the sustainable production of biomass feedstocks for biorefineries that produce power, fuels, chemicals and other valuable products."

Increased demand for production and processing of biomass will create new cash crops for America's farmers and foresters, many of whom currently face economic hardship. New processing, distribution, and service industries will be established in rural communities, and as the agricultural and forestry industries begin to provide feedstock for more than just food, feed and fiber, they will become an integral part of the transportation and industrial supply chain.

A new bioindustry will also encourage better use of agricultural and forestry residues, such as woody biomass. Last December President Bush signed the Healthy Forest Restoration Act, which was aimed at reducing forest fire risks by making productive use of thinnings from forest lands. These efforts will yield cellulosic materials in the form of brush and small diameter trees that could be converted into liquid fuels. Woody biomass utilization is an important part of a Memorandum of Understanding signed last year by the Departments of Agriculture, Interior and Energy.

Given the potential impact of our program on rural communities, we work very closely with the Department of Agriculture. The Biomass Act of 2000 created the formal framework that guides our efforts. The Act created the Biomass R&D Technical Advisory Committee, an advisory group to the Secretaries of Energy and Agriculture. The Committee includes 30 industrial and other biomass experts that advise the Department (and the Department of Agriculture) on program technical focus. The Committee also facilitates partnerships among Federal and State agencies, producers, consumers, the research community, and other interested groups. In October 2002, the Federal Advisory Committee released their Vision for the Bioenergy and Biobased

Products in the United States. The report sets aggressive goals to increase the role of biomass in the US economy by 2020 and beyond.

I am privileged to serve with Under Secretary Mark Rey from the Department of Agriculture as Co-chairs of Biomass R&D Board, which also includes high-level representatives from the Department of Interior, the Environmental Protection Agency, the National Science Foundation, the Office of Science and Technology Policy, and the Federal Environmental Executive. The Board interacts with the Committee to ensure that recommendations are considered and implemented, if it is determined that they will facilitate Biomass R&D.

Our Biomass program issues joint solicitations with the Department of Agriculture to competitively award funding for breakthrough technology development. This is an unprecedented level of cooperation between our two agencies that we hope to continue in the future.

Wind Technologies

Wind energy is a virtually emissions free electricity generation technology that eliminates all environmental concerns associated with conventional fuel cycles - extraction, emissions, and disposal. Wind energy is also one of the most widely used and fastest growing renewable energies in the world. Since 2000, nationwide installed wind turbine capacity in the United States has more than doubled. Largely because of the success of DOE sponsored research, the cost of electricity generation from wind has been reduced by a factor of 20 since 1982, to four cents or less per kilowatt-hour in areas with excellent wind resources.

Wind resources are widespread and substantial in many rural areas of the nation, particularly in the Midwest and West. The Department estimates that nearly $2 billion has been invested in 2003 alone with today's technology in new wind power facilities in more than a dozen states. Wind energy projects provide a new source of revenue to farms and ranches and an increased local tax base for rural communities. We estimate that our efforts with industry to achieve aggressive but credible growth in wind power over the next 20 years will create over $80 billion in capital investment in rural America, $1.5 billion in new income for farmers and rural landowners.

Here in Minnesota, it was a bold policy by the State and Northern States power (now Xcel Energy) that moved Minnesota into the forefront of wind development. The Prairie Island Compact allowed storage of spent nuclear fuel at the Northern States Power Nuclear Plant in exchange for the utility agreeing to acquire 425 MW of wind power and 100 MW of biomass. Today, Minnesota has more than 560 MW of wind energy from projects ranging in size from 2-100 MW.

It is important to note, however, that much of this growth is likely to come to an abrupt halt with the recent expiration of the Production Tax Credit for electricity produced from certain renewable sources, including wind. The Production Tax Credit provides a 1.8

cent per kilowatt-hour credit for electricity generated from wind, and plays a critical role in the financing of wind projects. In North Dakota more than half of the employees at DMI Industries, a manufacturer of wind turbine towers, were laid off just prior to the holidays last year. In Texas, Lone Star Transportation of Fort Worth, Tex., is projecting losses of as much as $ 1.5 million in revenue per month.

While there still remains economically viable opportunity in high quality wind resource areas with today's technology, the Department's R&D program focuses on technology that will make other, even more widely available, wind resources viable for development. This so called "low wind speed" technology will expand available land area for wind development by a factor of 20, while reducing average distance between the resources and where power is needed by a factor of five. Further opportunity is emerging in development of wind energy resources off the coasts and in the Great Lakes of the United States, which can bring immense, economically viable energy sources close to major urban areas with growing demand and increasingly limited energy production and delivery options.

Although wind power can provide electricity at some of the lowest costs available from new generation sources, barriers remain to full realization of the Nation's wind power potential. Cost is still the primary barrier. After cost, the capability to integrate wind power into its range of applications - providing electricity to the grid, serving remote, standalone power needs, or producing hydrogen or clean water in the future - poses both technical and institutional challenges.

Geothermal Energy

Geothermal energy is an inherently clean source of heat that can be used for space heating, aquaculture, greenhouses, and other applications in rural communities. Geothermal energy is a non-combustion source of energy, so no carbon, sulfur or nitrogen oxides are produced. And geothermal energy is a stable source of energy not subject to price swings such as in the natural gas or fuel oil markets.

Low-and-medium temperature geothermal resources exist throughout the western United States. A survey of 16 western states identified more than 9,000 thermal wells and springs, more than 900 low-to-moderate temperature geothermal resource areas, and hundreds of direct use sites. There are 404 resource sites within five miles of a community in 16 western states that have a potential of serving 9.2 million people. Currently there are 41 geothermal greenhouse operations in nine western states, and 48 geothermal aquaculture operations in 11 western states. Many opportunities exist for the future development of new geothermal sites into thriving greenhouse or aquaculture businesses. Other opportunities include the processing of fruit and vegetable products where geothermal energy provides an even heat source superior for dehydration.

Our program has also supported ground source heat pumps, heating and cooling systems that can be applied to most rural areas. They do not require a low-to-medium temperature geothermal resource but instead use the near surface ground as a heat source

during the heating season and as a heat sink during the cooling season. More than half a million ground source heat pumps are installed in the United States, and they are being installed at a rate of about 35,000 units per year. In rural areas, ground space to install the ground loop, either in a horizontal or vertical loop configuration, should be readily available, or in lieu of a ground loop, ground water can be pumped directly to the heat pump.

Solar Energy Technology

Our solar energy technology program focuses on advanced solar devices that can harness a widely available domestic energy resource to help meet electricity needs and reduce the stress on the electricity infrastructure. The photovoltaic program is focused on next-generation technologies such as thin-film photovoltaic cells and leap-frog technologies such as polymers and nanostructures that can increase system durability and develop technologies to improve interconnections with the electric grid. Our research and development seeks primarily to reduce the manufacturing cost of highly reliable photovoltaic modules.

Our program also supports efforts to develop hot water and space heating for residential, commercial and farm buildings in collaboration with industry partners. The program uses new formulations of lightweight polymer materials to modernize solar water heaters, making them easier to install, while lowering the cost of solar water heating in non-freezing climates.

Solar systems are used in many agricultural applications today, and as the cost is reduced further through R&D, more cost-effective applications will open. On farms and ranches, photovoltaics can be used to pump water, to supply power to buildings, and to operate labor-saving equipment far from utility lines. Using solar photovoltaics is often cheaper than the alternatives, such as running a new power line, if the location of the power needed, such as a well pump, is a mile or more away from the main power lines. Further, the versatility and portability of small systems are attractive for a variety of needs in rural America, such as on ranches where portable pumping systems are needed.

Renewable Energy and the Hydrogen Fuel Initiative

Mr. Chairman, you'll recall that at the Science Committee earlier this month we discussed the President's Hydrogen Fuel Initiative in light of a study by the National Research Council. This potential solution to problems caused by petroleum dependence holds the promise of virtually limitless clean, safe, secure, affordable, and reliable energy from domestic resources. We discussed that producing the amount of hydrogen needed in a hydrogen economy will require a variety of domestic feedstocks. To the extent that hydrogen is produced from renewable sources of energy, we will not only be producing a clean domestic energy carrier to power emission free cars, we will be helping to improve the economies of rural America. DOE is actively supporting research and development into all of these routes to renewable based hydrogen.

Biomass

According to the National Research Council report, hydrogen from biomass is one of the earliest and lowest cost options from renewable resources (with near net zero CO2 emissions). Biomass can be used to produce hydrogen through gasification or pyrolysis. In gasification, the biomass is directly converted to gaseous hydrogen in large central plants. To produce hydrogen at costs competitive with gasoline by this route, the cost of the biomass feedstock, the capital cost of the gasification process, and the cost of transporting hydrogen from central plants to refueling stations all need to be reduced. Another potential route is biomass pyrolysis that results in a liquid bio-oil that can then reformed to hydrogen. The pyrolysis pathway is currently more costly than biomass gasification due to somewhat higher capital costs.

Wind

Wind generated electricity can be used in combination with electrolysis to produce hydrogen. The electricity could be produced centrally and the electrolysis could be done in a distributed manner at refueling stations. To be competitive with the cost of gasoline, the cost of the electricity needs to be reduced and better electrolysis technology needs to be developed to reduce the electrolyzer capital cost.

In another approach, large electrolyzers could be placed at central wind farms. The wind farm could co-produce hydrogen and electricity. While the wind resource is intermittent, hydrogen could be made and stored when there is a lot of wind and less need for electricity. A fuel cell could utilize the stored hydrogen to produce electricity when there is too little wind and a high need for electricity on the grid. Advances in technology are needed to reduce the cost of hydrogen storage, to reduce the capital costs and increase the size of electrolyzers, and to further reduce the capital cost and durability of fuel cells.

Some envision distributed wind electricity and hydrogen production, perhaps even at refueling stations. This would require cost reduction in hydrogen storage, more cost effective wind turbines, and lower cost electrolyzers.

Solar

There are several routes to produce hydrogen from solar energy. One of the most attractive long term options for hydrogen production is direct water splitting using photo-active materials or photobiological processes. While the feasibility of this process has been demonstrated, breakthroughs in material costs, durability and efficiency are required for this to be viable. Photovoltaics could also be used to generate electricity while electrolysis is used to generate hydrogen. This option is very similar to the wind electrolysis option with similar barriers. Also the cost of electricity from solar photovoltaics is currently higher than that from wind.

Research is underway to try to utilize high temperature thermochemical cycles to produce hydrogen. There are several chemical cycles that recycle all of the chemical constituents

while splitting water to form hydrogen. These could use solar concentrators as the source of the energy to generate the high temperatures required. This research is in a very early stage of exploration ands development but could be a very attractive long term option.

Conclusion

Mr. Chairman, we have made great strides in our research, development and deployment programs for renewable energy sources -- solar, geothermal, wind, hydropower, and biomass. And the Administration continues to strongly support comprehensive energy legislation that would include incentives for renewable energy, including production tax credits for renewable energy, a renewable fuels standard to support ethanol and biodiesel, and a variety of energy efficiency provisions to help us use all of our energy resources more efficiently.

Mr. Chairman, that completes my prepared statement. I would be happy to answer any questions at this time.